

WHAT IS CLAIMED IS:

1. A recombinant vector for expressing a heterologous peptide at the amino-terminus of a potyvirus coat protein, the vector comprising:
 - (a) sufficient potyvirus nucleic acid sequence to permit viral replication and spread within a plant infected by the vector; and
 - (b) a heterologous nucleic acid sequence inserted at the amino-terminus of the potyvirus coat protein.
2. The recombinant vector of claim 1, wherein the amino-terminus is selected from the group consisting of:
 - (i) an established amino-terminus of a wild type potyvirus coat protein; and
 - (ii) an alternate amino-terminus of a potyvirus coat protein, said alternate amino-terminus arising from an action selected from the group consisting of an insertion, a replacement and a deletion of at least one amino acid residue from said known amino-terminus.
3. The recombinant vector of claim 1, wherein said heterologous nucleic acid sequence encodes at least a portion of the heterologous peptide.
4. The recombinant vector of claim 1, wherein the potyvirus is zucchini yellow mosaic virus (ZYMV).
5. The recombinant vector of claim 1, wherein the potyvirus is selected from the group consisting of ALMV, AmLMV, ArjMV, ArLV, AV-1, BCMV, BCNMV, BYMV, BtMV, BiMoV, CdMV, CVMV, CTLV, CeMV, ChiVMV, CIYVV, CSV, CDV, ComMV, CABMV, CGVBV, DsMV, DSTV, DeMV, GSMV, GEV, GGMV, HVY, HMY, HiMV, IFMV, IMMV, ISMV, JGMV, KMY, LYSV, LMV, MDMV, NDV, NYSV, NoMV, OYDV, ORMV, BRSV, PARMV, PWV, PSBMV, PEMOV, PEPMOV, PESMV, PVMV, PTV, PPV, PKMV, PVA, PVV, PVY, RETBV, SRMV, SMV, SCMV, SPFMV, TAMMV, TEMV, TEV, TVMV, TBBV, TBV, TSBV, TUMV, WMV-2, WVMV, YMV and ZYFV.

6. The recombinant vector of claim 1, wherein said potyvirus nucleic acid sequence and said heterologous nucleic acid sequence are each selected from the group consisting of a DNA sequence, an RNA sequence a cDNA sequence and combinations thereof.
7. The recombinant vector of claim 1, wherein the coat protein of the potyvirus includes an amino-terminal domain.
8. The recombinant vector of claim 7, wherein said amino-terminal domain is modified by deletion of at least 1 amino acid residue.
9. The recombinant vector of claim 3, wherein fusion to the potyvirus coat protein influences a biological activity of said at least a portion of the heterologous peptide.
10. The recombinant vector of claim 3, wherein said at least a portion of a heterologous peptide is selected from the group consisting of an antigen, a receptor, a ligand, an enzyme, a surfactant, a pore forming molecule, a chaperone, a nucleic acid binding molecule, a transcription factor, an inhibitor, an ion binding molecule, a carbohydrate binding molecule and a signal transducer.
11. The recombinant vector of claim 3, wherein said at least a portion of the heterologous peptide is capable of eliciting an immune response when appropriately administered to an animal.
12. The recombinant vector of claim 11, wherein said animal is selected from the group consisting of an insect, a fish, a bird, a reptile and a mammal.
13. The recombinant vector of claim 12, wherein said mammal is selected from the group consisting of a house pet, a laboratory animal, a sheep, a goat, a cow, a pig, a monkey, an ape and a human being.
14. The recombinant vector of claim 1, further comprising an amino acid substitution in the HC- Pro gene of the conserved FRNK box of

said potyvirus nucleic acid sequence, said substitution causing attenuation of the potyvirus.

15. The recombinant vector of claim 1, further comprising an amino acid substitution in said potyvirus nucleic acid sequence, said substitution effectively abolishing aphid transmissibility of the potyvirus.

16. The recombinant vector of claim 1, wherein said heterologous nucleic acid sequence encodes at least a portion of a peptide selected from the group consisting of cMYC, FMDV, His tag and Ovalbumin.

17. The recombinant vector of claim 16, wherein said heterologous nucleic acid sequence comprises at least a portion of at least one member selected from the group consisting of SEQ ID NOs.: 4, 8, 20 and 28.

18. The recombinant vector of claim 1, wherein said heterologous nucleic acid sequence encodes at least a portion of at least one peptide selected from the group consisting of SEQ ID NOs.: 5, 9, 21 and 29.

19. The recombinant vector of claim 1, wherein the vector comprises at least a portion of at least one item selected from the group consisting of SEQ ID Nos.: 6, 7, 10-19, 22-27, 30 and 31.

20. The recombinant vector of claim 1, further comprising one additional amino acid residue, said additional amino acid residue facilitating proteolytic excision of the coat protein from within a potyvirus polyprotein.

21. The recombinant vector of claim 20, wherein said additional residue is selected from the group consisting of serine, methionine, glycine, alanine and phenylalanine.

22. The recombinant vector of claim 1, wherein translation of said potyvirus nucleic acid sequence encoding a portion of an amino-terminal domain of a potyvirus coat protein and said heterologous nucleic acid

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sequence fused thereto produces a fusion protein with an isoelectric point similar to an isoelectric point of a native potyvirus coat protein.

23. A method of transiently expressing at least a portion of a heterologous peptide in at least a portion of a plant, the method comprising the steps of:

- (a) providing a recombinant vector comprising;
 - (i) sufficient potyvirus nucleic acid sequence to permit viral replication and spread within a plant infected by the vector;
 - (ii) a heterologous nucleic acid sequence inserted at the amino-terminus of the potyvirus coat protein;
 - (b) introducing at least one copy of said vector into at least one cell of the plant; and
 - (c) cultivating the plant so that said vector is transcribed, the resulting nucleic acid replicating therein by forming viable potyvirus virions which spread from cell to cell within the plant;
- wherein each of said viable potyvirus virions displays on an external surface thereof a plurality of copies of the at least a portion of the heterologous peptide.

24. The method of claim 23, wherein the vector is transcribed extrachromosomally.

25. The method of claim 23, wherein the plant is a cucurbit plant.

26. A plant transiently expressing at least a portion of a heterologous peptide in at least a portion thereof, the plant comprising:

- (a) at least one cell infected with a recombinant vector for expressing the at least a portion of the heterologous peptide, the vector comprising;
 - (i) sufficient potyvirus nucleic acid sequence to permit viral replication and spread within the plant infected by the vector;
 - (ii) a heterologous nucleic acid sequence inserted at the amino-terminus of the potyvirus coat protein

wherein said vector is transcribed extrachromosomally, thereby forming viable potyvirus virions capable of replicating and spreading from cell to cell within the plant; and

wherein each of said viable potyvirus virions displays on an external surface thereof a plurality of copies of said at least a portion of a heterologous peptide.

27. The plant of claim 26, wherein the plant is a cucurbit plant.

28. A method of vaccination, the method comprising the steps of::

- (a) providing a recombinant vector comprising;
 - (i) sufficient potyvirus nucleic acid sequence to permit viral replication and spread within a plant infected by the vector;
 - (ii) a heterologous nucleic acid sequence inserted at the amino-terminus of the potyvirus coat protein, wherein said heterologous nucleic acid sequence encodes at least one antigenic determinant;
- (b) introducing at least one copy of said vector into at least one cell of a plant;
- (c) cultivating said plant so that said vector is transcribed therein resulting in the formation of viable potyvirus virions which replicate and spread from cell to cell within said plant;

wherein each of said potyvirus virions displays on an external surface thereof a plurality of copies of said at least one antigenic determinant;

- (d) harvesting at least a portion of said plant; and
- (e) delivering said potyvirus virions to a subject, such that said plurality of copies of said at least one antigenic determinant contained therein elicit an immune response from said subject.

29. The method of claim 28, comprising the additional step of isolating said potyvirus virions from said at least a portion of said plant.

30. The method of claim 28, wherein said step of delivering includes oral administration to said subject.

31. The method of claim 28, wherein said step of delivering and said step of harvesting are carried out concurrently.

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33. The method of claim 28, wherein said plant is a cucurbit plant.

35. The method of claim 28, wherein said vector replicates outside a nucleus of said at least one cell of said plant.